

Problem 4: Water Bottles

4+3=7 Point(s)

Problem ID: `bottles`

Rank: 2+3

Introduction

Berkeley students living in some parts of the Foothill residential complex source most potable water from a communal water dispenser. This problem is inspired by an everyday technique we use to reduce the awkwardness of delaying people behind us in line! The real dispenser outputs 2 liters per minute, but we'll say 1 per minute for this problem to make things simpler.

Problem Statement

N students numbered $1, \dots, N$ are lined up at a water dispenser that dispenses water at a constant rate of 1 liter per minute. The i^{th} student has an empty bottle with capacity C_i liters that they begin to fill immediately after the previous student has finished (formally, the i^{th} student begins refilling when all j^{th} students for which $j < i$ finish refilling).

We define the *wait time* of a student as the **total** time they have to wait until their bottle **finishes** refilling. The students ask you to reorder the line into a new permutation (a_1, \dots, a_N) of the students' numbers such that the students' total wait time is minimized.

For the bonus test set only, the students also require a tiebreaker: If multiple permutations result in the minimum total wait time, choose any permutation that minimizes the number of students moved to a new position. Formally, minimize the number of indices i for which $a_i \neq i$. If there are multiple permutations that accomplish this, you may choose any.

Input Format

The first line of the input contains an integer T , denoting the number of test cases that follow.

For each test case:

- The first line contains a positive integer N denoting the number of students in line.
- The second line contains a sequence of N positive integers C_1, \dots, C_N , denoting the bottle capacities in liters.

Output Format

For each test case, output the following two lines:

- On the first line, output the minimum total wait time in minutes.
- On the second line, output N integers a_1, \dots, a_N ($1 \leq a_i \leq N$) where a_i is the new index of the i^{th} student from the front of the original line. If there are multiple permutations that satisfy all criteria, you may output any.

Constraints

$$1 \leq T \leq 100$$

Main Test Set

$$1 \leq N \leq 10^3$$

The sum of N across all test cases in a test file does not exceed 10^3 .

$$1 \leq C_i \leq 10^3$$

All capacities C_i are distinct.

There is guaranteed to exist exactly one optimal permutation for each test case.

Bonus Test Set

$$1 \leq N \leq 10^5$$

The sum of N across all test cases in a test file does not exceed 10^5 .

$$1 \leq C_i \leq 10^9$$

The capacities C_i are not guaranteed to be distinct.

Sample Test Cases

Main Sample Input

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```
1
3
5 1 2
```

Main Sample Output

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```
12
2 3 1
```

Main Sample Explanations

The optimal permutation rearranges the line into the order (2, 3, 1).

1. Student 2 is first in the new line. They have a 1 L bottle and spend 1 minute refilling it.
2. Student 3 is second. They have to wait 1 minute and then spend 2 minutes refilling their own bottle, finishing after 3 minutes.
3. Student 1 is third. They have to wait 3 minutes and then spend 5 minutes refilling their own bottle, finishing after 8 minutes.

The total wait time is $(1 + 3 + 8) \text{ min} = 12 \text{ minutes}$, and it can be shown that no other permutation results in a total less than or equal to than 12 minutes.

Bonus Sample Input

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```
2
3
2 1 1
4
2 2 1 1
```

Bonus Sample Output

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```
7
3 2 1
13
3 4 1 2
```

Note that this is one of many possible correct outputs. If there are multiple solutions, you may output any of them.

Bonus Sample Explanations

For test case #1, the permutations (2, 3, 1) and (3, 2, 1) both achieve the minimum total wait time of 7 minutes. However, (2, 3, 1) moves three students while (3, 2, 1) moves only two, so (3, 2, 1) is preferred.

For test case #2, the permutation (3, 4, 1, 2) moves all students and results in a total wait time of 13 minutes, which can be shown to be the minimum. There are also three other permutations that result in a total wait time of 13 minutes and move all students: (3, 4, 2, 1), (4, 3, 1, 2), and (4, 3, 2, 1). The tiebreaker is thus inconclusive—any of these permutations are acceptable.